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Clontuskert Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/34
March 2023

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This sand and gravel report forms part of a series representing the output of a body of work undertaken to re-evaluate previously mapped sand and gravel aquifers and to identify new sand and gravel aquifers. This study resulted in the refinement of existing sand and gravel aquifer mapped extents, the modification of some sand and gravel aquifer categories, and the removal of some previously mapped sand and gravel aquifers, as well as identification of new aquifers. In addition to mapping the extent and depths of the sand and gravel aquifers, the investigations consider the hydraulic properties.

The study, undertaken as part of the GW3D project (2015-2019), comprised three parts:

1) Desk study and fieldwork preparation

Sand and gravel bodies above a minimum size criterion were extracted from the GSI Quaternary Sediments 1:50,000 map. Where it was known that the surface expression of the sands and gravels was only a small portion of the subsurface body, such areas were retained. This process left several hundred sand and gravel bodies remaining as a starting point for field work.

2) Fieldwork including mapping and data collection

Field work included a visit to each of the areas which had the potential to be (at least) a Locally Important Sand and Gravel Aquifer owing to its area. In such areas, gravel pits and sand pits were visited and depth and type of sediment recorded, other exposures into the subsurface were visited and logged, wells (whether Public Supply, Group Scheme or private farm or domestic) were dipped and any information on depths recorded, and data was collected where geological and hydrogeological data existed for the area.

3) Data collation, analysis and reporting.

All field data, and information from earlier reports and studies, were compiled and analysed. Where a sand and gravel body had qualifying aquifer properties (either 10 m depth sand and gravel, or 5 m depth saturated sediments), these areas were digitised in a GIS. The aquifer area was then ascertained and drawn up. Such areas formed the basic building blocks for the sand and gravel aquifer map, which included details on the aquifer name, area, aquifer resource value (Rg or Lg), confidence level, county, and any important aspects to note for each body.

The updated mapped sand and gravel aquifers are found on the Geological Survey Ireland site <https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx#Aquifers>

The GW3D Mapping Team involved in the current revision of delineated sand and gravel aquifers were:

Geological Survey Ireland staff:

- Dr. Sophie O'Connor, Groundwater Programme / Land Mapping Unit
- Dr. Sarah Blake, Groundwater Programme

Consultant support:

- Dr. Robbie Meehan, Talamh Ireland
- Coran Kelly, Tobin Consulting Engineers
- Damien Doherty, independent Consultant Geologist/ Tobin Consulting Engineers
- Natalie Duncan, independent Consultant Geologist
- Sara Raymond, independent Consultant Geologist
- James McAteer, Gavin and Doherty Geosolutions



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Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
26 – Upper Shannon Galway County Council		Rivers: Ballinure River, Cloonescragh River Streams: Several unnamed streams Lakes: None	Suck River Callows SPA Suck River Callows NHA Cloonascragh Fen and Black Wood pNHA	4.39
Topography	The Clontuskert sands and gravels are situated 4 kilometres south of Ballinasloe, and comprise glaciofluvial sands and gravels and an east-west oriented band of eskers (Coxon and Browne, 1991), within a relatively low-lying, gently hummocky area which parallels the course of the Ballinure – Cloonescragh Rivers (Figure 1). Surface elevations of the sands and gravels range from 35 m to 50 m AOD. Cutover raised peat and/or alluvial sediments cover a large portion of the delineated aquifer area.			
Geology and Aquifers	Aquifer categories	It is considered that a large portion of the delineated aquifer body has >10 m depth sands and gravels, based on topography, geotechnical data analysis and examination of exposures. Deposits are likely to be shallower along the southern boundary of the body. Groundwater level data derive from trial hole assessments at the Raymond Kenny sand and gravel pit, south of Cloonascragh (Hydro Environmental Ltd., 2006), and from a trial hole assessment for a planning application c. 500 m southwest of Kellysgrove (Galway Co. Co. Planning Application, 73803). The data suggest that groundwater levels within the body of sands and gravels are generally close to the ground surface, and at similar levels to those of surface water. Based on likely geometry and extent, this deposit is classified as a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017), and overlies bedrock of Dinantian Upper Impure Limestones, which is a Locally Important Aquifer (LI) (GSI, 2017).		
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from limestones (GLs), and eskers comprised of gravels of basic reaction (BasEsk; GSI, 2023b).		
	Key structures	Exposures from a gravel pit at Cloonascragh show thick layers sand and gravel deposits, with moderate sorting, interspersed with thin layers of well sorted sands.		
	Key properties	There are no known data in this aquifer on yields, permeabilities or transmissivities. Sand and gravel aquifers generally consist of unconsolidated, coarse-grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000). Typically transmissivity ranges from 200 – 1500 m ² /d (Kelly et al., 2015). Specific yield is expected to be high (10%). Groundwater is considered to be unconfined within the Clontuskert sand and gravel aquifer. The data are inadequate to calculate groundwater gradients, but these are expected to be relatively flat, in the order of 0.001, typical of sand and gravel aquifers.		
	Thickness	Depth to bedrock is 37 m BGL at Kellysgrove, c. 20 m north of the area of the delineated aquifer body, and there is evidence of rock outcropping at Clontuskert Bridge and Lismanny Bridge, both close to the southeastern boundary of the body also. Exposures from a pit at Cloonascragh show up to 8 m depth of sands and gravels. The depth to bedrock at Kellysgrove is 37 m BGL. Based on these data and the topography of the area, it is expected that the majority of the sand and gravels deposits are >10 m thick.		
Overlying Strata	Lithologies	Glaciofluvial sands and gravels at surface, with relatively large portions covered by cutover raised peat, and alluvium.		
	Thickness	Where cutover peat and alluvium occurs, they are inferred to be less than 3 m thick.		
	% area aquifer near surface	Approximately 59% of the sand and gravel aquifer is just below the surface. It is possible that the sand and gravel aquifer extends further eastwards beneath the peat, towards the River Suck, but there was no evidence to support this at the time of writing.		
	Vulnerability	The groundwater vulnerability of the sand and gravel aquifer is 'Extreme' wherever the water table is <3 m from the surface, whereas in all other areas where the water table is at depths >3 m from surface, the vulnerability is classed as 'High'. Extreme vulnerability occurs over approximately 95% of the delineated aquifer area.		



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Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table where sands and gravels are at surface. It is assumed that a small amount of rejected recharge enters the aquifer from the higher ground at Abbeypark, to the south and southwest of the sand and gravel body.
	Est. recharge rates	Recharge to the aquifer is estimated at 395 mm/yr, based on an average annual rainfall of 969 mm/yr (Walsh, 2012). This give a minimum direct groundwater throughput of 1,734 m ³ /d, which rises to a potential 2,052 m ³ /d when rejected recharge from the adjacent higher ground to the southwest and south is included.
Discharge	Large springs and large known abstractions (m ³ /d)	There are no known large springs or abstractions from this aquifer body.
	Main discharge mechanisms	Groundwater is expected to discharge <i>via</i> some small lowlying springs as seen on OSI 6 inch raster map (1830s – 1930s) at, for example, Ballymanagh and Abbeypark Townlands. Groundwater also discharges, <i>via</i> seeps, to the Ballinure River and the Cloonescragh River, and to several unnamed small streams that flow through the aquifer body.
	Hydrochemical Signature	Hydrochemistry data from the Environmental Impact Statement for Raymond Kenny sand and gravel pit (Hydro Environmental Ltd., 2006) has insufficient data to determine the hydrochemical signature; however, based on the geology of the area, it is expected that the signature is of calcium bicarbonate (Ca-HCO ₃). Of the parameters analysed for in the assessment, only total coliforms was above the limit for drinking waters; this is expected, given the groundwater vulnerability of that locality.
Groundwater Flow Paths		The length of flow paths depend on the size of the sand and gravel deposit. In general, locally important sand and gravel aquifers are expected to have relatively short flow paths, <i>i.e.</i> up to several hundred metres. This is also expected to be the case at Clontuskert, given the geometry and setting of the sand and gravel body.
Groundwater & Surface water interactions		Groundwater is expected to discharge to the rivers, streams, as specified above. Hydraulic connection between the groundwater in the aquifer, the adjacent rivers and streams is expected to be high.
Conceptual model	- The Clontuskert sand and gravel aquifer comprises glaciofluvial sands and gravels derived chiefly from limestones (GLs) and eskers comprised of gravels of basic reaction (BasEsk). - The deposits are situated in a generally low-lying, flat to hummocky area, lying at elevations between 35 m and 50 m AOD. - The sand and gravel body is covered with relatively extensive areas of cutover raised peat and alluvium, which cover approximately 41% of the area of the delineated aquifer body. - The sand and gravel subsoils overlie bedrock of Dinantian Upper Impure Limestones, which is a Locally Important Aquifer (LI). - The sands and gravels in the aquifer are inferred to be greater than 10 m deep over much of their extent, with c. 36% of the aquifer body estimated as having ≥5 m depth sand and gravel saturation. - Across approximately 95% of the aquifer area, groundwater levels are mapped as being <3 m BGL. - The length of groundwater flow paths is expected to be in the order of several hundred metres. - Groundwater discharges <i>via</i> seeps and springs to the Ballinure River and the Cloonescragh River, and to several unnamed streams, as well as to springs set within the sand and gravel body. - Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels. Recharge to the aquifer is estimated as 395 mm/yr. - This give a minimum direct groundwater throughput of 1,734 m³/d, which rises to a potential 2,052 m³/d when rejected recharge from the adjacent higher ground to the southwest and south is included.	



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Attachments	Table 1: Raw water analysis of BH2 from Kenny's Quarry, December 2006 Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability
Instrumentation	Hydrometric gauges: 26038 Ballinure (active staff gauge) National Water Monitoring Stations; River: RS26B010300 Ballinure Bridge RS26B010400 Br N of Ballymanagh Lodge Groundwater: None present
Information Sources	- Coxon, P. and Browne, P. (1991). Glacial deposits and landforms of central and western Ireland. In: Ehlers, J., Gibbard, P. and Rose, J. (Eds.) <i>Glacial Deposits in Great Britain and Ireland</i>. A.A. Balkema, Rotterdam, pp. 355-365. - DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. - EPA (2023a). Environmental Protection Agency Map Viewer. https://gis.epa.ie/EPAMaps. - EPA (2023b). Groundwater Monitoring Data to End 2017. - GSI (2017). A description of Irish aquifer categories. 3 pp. Available from: https://www.gsi.ie/documents/GSI%20Aquifer%20Category%20Descriptions.pdf - GSI (2023a). Geological Survey Ireland internal groundwater database. - GSI (2023b). Geological Survey Ireland Map Viewer. https://www.gsi.ie/en-ie/data-and-maps - Kelly, C., Hunter Williams, T., Misstear, B.M. and Motherway, K. (2015). Irish Aquifer Properties – A reference manual and guide. Prepared on behalf of the Geological Survey of Ireland and the Environmental Protection Agency. 110 pp. - Hydro Environmental Ltd. (2006). Proposed quarry development, Cloonascragh, Ballinasloe, County Galway – hydrological and hydrogeological assessment. Report on behalf of Raymond Kenny, Galway County Council Planning Ref. No. 06/2709. - NPWS (2023). National Parks and Wildlife Service Map Viewer. http://webgis.npws.ie/npwsvviewer - Ó'Súilleabháin, C. (2000). Assessing the boundary between high and moderately permeable subsoils. Unpublished MSc., University of Dublin. Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. - Walsh, S. (2012). A Summary of Climate Averages 1981-2010 for Ireland, Climatological Note No.14, Met Éireann, Dublin.
Disclaimer	Note that all calculations and interpretations presented in this report represent estimations and assumptions based on the information sources described above and established hydrogeological formulae. Figures 1, 2 and 3 are used for illustrative purposes only.



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Parameter	Concentration	¹ Drinking Water Limit (DWL) or ² Threshold Value (TV)
pH (pH Units)	7.73	6.5-9.5 (DWL)
Conductivity (µS/cm)	772	2,500 (DWL), 800-1875 (TV)
Alkalinity (mg/l CaCO ₃)	310	(-)
Ammonium (mg/l N)	0.2	0.3 (DWL), 0.065-0.175 as N (TV)
Sulphate (mg/l SO ₄)	11	250 (DWL), 187.5 (TV)
Chloride (mg/l)	21	250 (DWL), 24-187.5 (TV)
Sodium (mg/l)	7.0	200 (DWL), 150 (TV)
Potassium (mg/l)	1.1	(-)
Potassium:Sodium	0.16	0.4 (indicator)
Total Coliforms (MPN/100ml)	88	0 (DWL)
Faecal Coliforms (<i>E. coli</i>) (MPN/100ml)	0	0 (DWL)

¹S.I. No. 122/2014 - European Union (Drinking Water) Regulations 2014

²S.I. No. 9/2010 – European Communities Environmental Objectives (Groundwater) Regulations 2010

Table 1: Raw water analysis of BH2 from Kenny's Quarry, December 2006 (Hydro Environmental Ltd, 2006)

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Clontuskert Sand and Gravel Aquifer

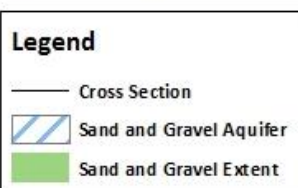
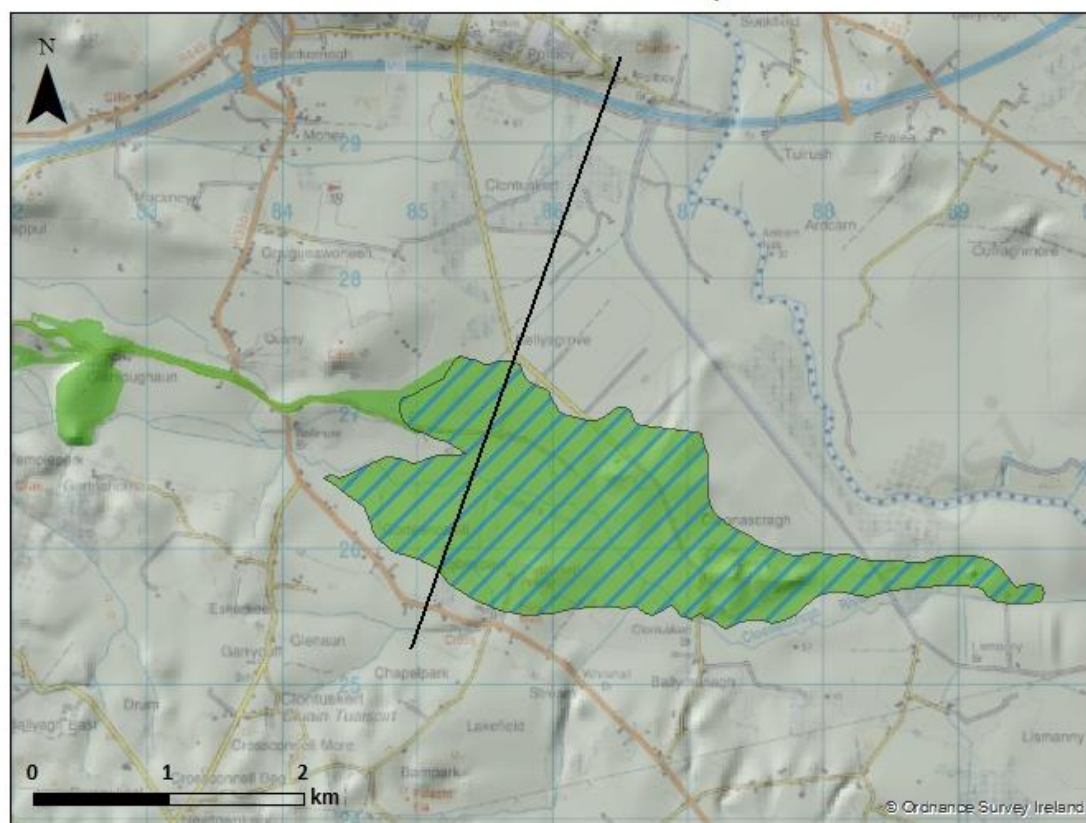
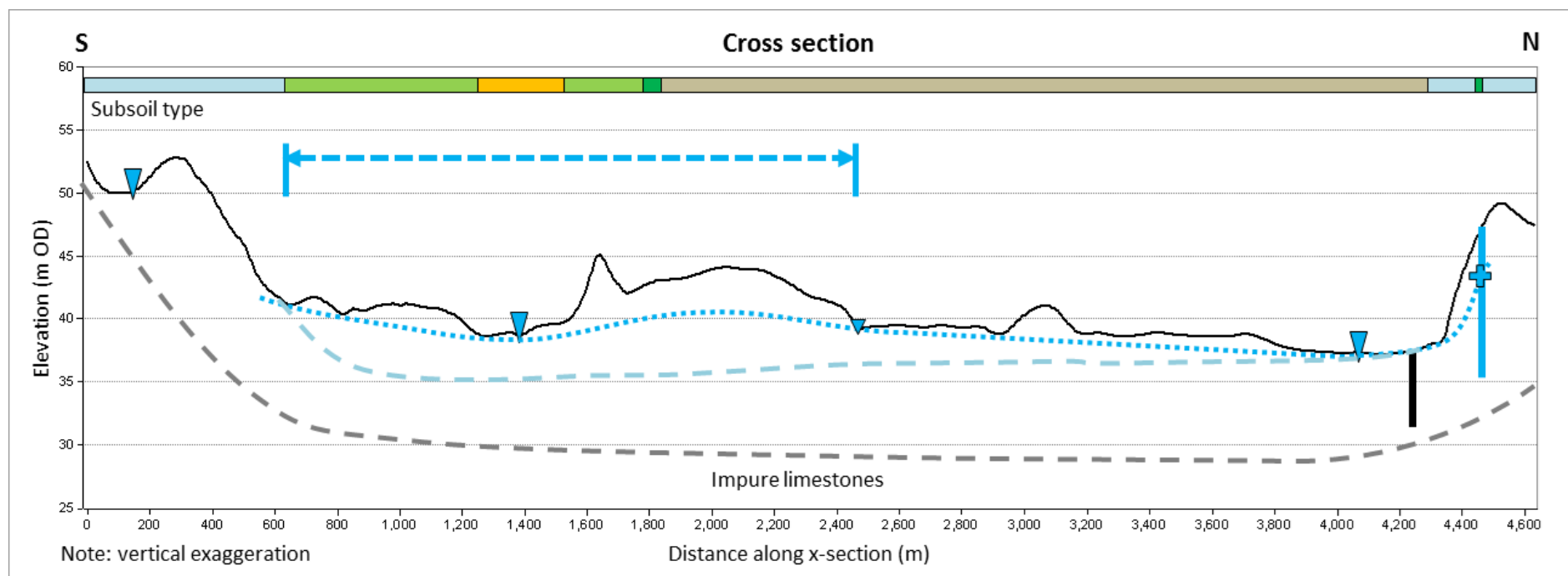


Figure 1: Clontuskert Sand and Gravel Aquifer extent with cross section location.

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LEGEND			
Feature		Subsoil Type	
Topography		Sands and gravels	
Groundwater level		Esker	
Top of bedrock		Windblown sands	
Borehole/Trial Pit		Till	
Dug well		Peat	
S&G exposure		Rock outcrop	
Active quarry		Alluvium	
Freshwater lake		Lake sediments	
GW Ponding		Top of S&G	
River		Top of till	
Stream/drainage channel		Karst Feature	
Spring		Spring	
Aquifer envelope		Turlough	

Figure 2: Cross section through the Clontuskert Sand and Gravel Aquifer body.

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Clontuskert Sand and Gravel Aquifer Vulnerability

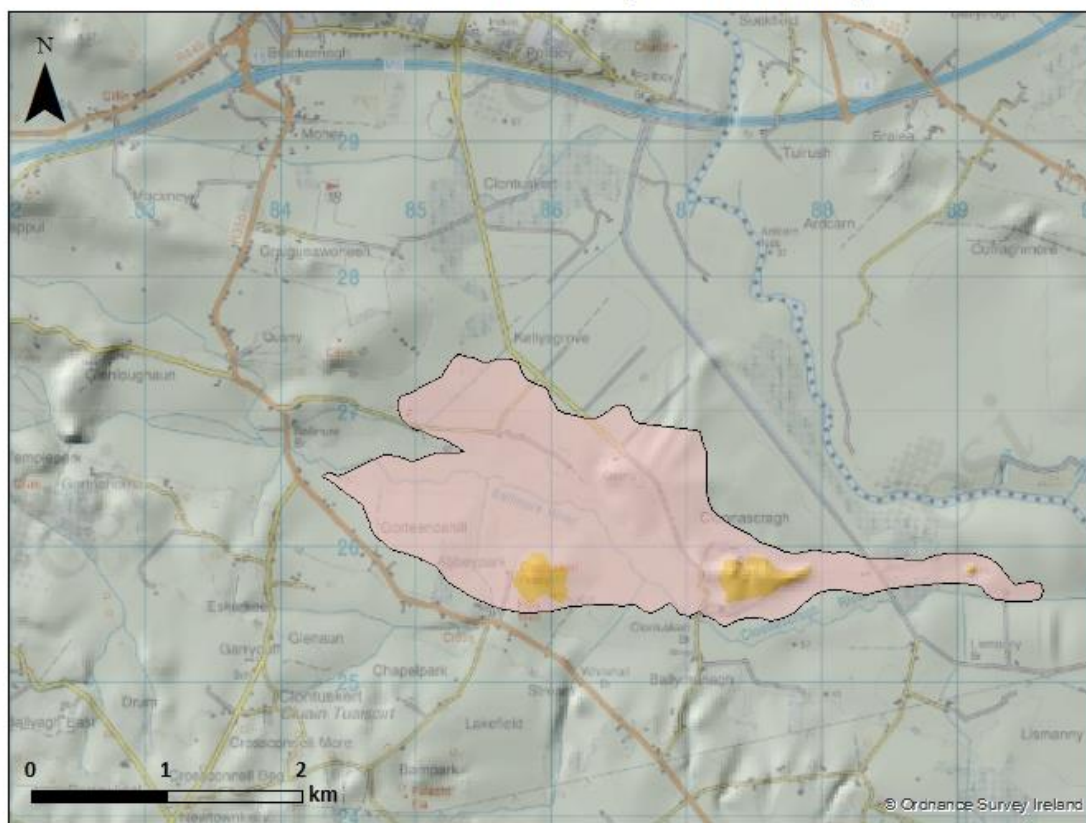


Figure 3: Groundwater vulnerability across the Clontuskert Sand and Gravel Aquifer.